presented by the publishers; Berlin Observatory, Zonenbeobachtungen 20° bis 25°, presented by the Observatory; Padua University, Papers relating to the Galileo Tercentenary, presented by the University; *Nautical Almanac* for 1896, and ditto, part i., presented by the Admiralty; Fifteen lantern slides of solar prominences, faculæ, &c., taken at the Kenwood Observatory, Chicago, presented by Professor G. E. Hale; Seven lantern slides of lunar eclipse, 1892, May 11, presented by Mr. Newbegin.

Opposition of Mars, 1892. *Observations made at the Royal Observatory, Cape of Good Hope.* By David Gill, LL.D., F.R.S., H.M. Astronomer.

When Professor Eastman's programme reached the Cape I removed the declination micrometer frame of the transit circle, and with the apparatus which is attached for this purpose to our Repsold photograph-measuring micrometer ruled a pair of lines upon it and inserted a new pair of webs, 16″ apart, parallel to the old declination web.

Subjoined are the data relative to the distance and inclination of the wires thus inserted.

The distance between the wires at the middle wire was found to be 16″·03.

The inclination was determined as follows:—

1. The transit circle pointing north was placed horizontal, and the north collimator was rotated about its optical axis till the horizontal web of the collimator became parallel to that of the transit circle.

2. The south collimator was directed upon the north collimator, and its horizontal wire adjusted to parallelism with that of the north collimator.

3. The transit circle was then directed to the south collimator, and the inclination of its horizontal wire with respect to the corresponding collimator wire was measured. It is clear that half the apparent inclination of the horizontal web of the transit circle to that of the south collimator will then be the true inclination of the transit-circle web.

The process is an exceedingly accurate one, independent determinations on June 23, 27, 29, and 30 giving practically identical results.

For the new wires (named Y and Z) the mean corrections were:—

At point of intersection by the vertical webs

	α	β	I	Middle Wire.	7	γ	δ
	″	″	″		″	″	″
Y	−0·06	−0·01	+0·02		+0·02	−0·04	+0·06
Z	−0·02	+0·01	−0·02		+0·03	−0·01	+0·05

These are the actual means of observations, which should, of course, be smoothed to quantities proportional to the distance, if rigorous corrections were required for inclination. But the method of observation has been so arranged that the effect of inclination of the wires is entirely eliminated. In observing stars, the image was first bisected near wire α with wire Y and near wire 1 with Z; the reversing prism was then rotated 90° on its axis and the star again bisected with Z near wire 7 and with Y near wire δ; or Z might be used first to bisect near wire α, in which case it was also used to bisect near wire δ, while Y was used at wires 1 and 7. Thus, in every case, the prism was reversed between the observations at wires 1 and 7, and the star was bisected by both wires in each position of the prism.

The interval from α to 1, 1 to 7, 7 to δ is about twenty-six seconds, allowing ample time to read the declination micrometer.

In observing the image of *Mars*, the pointings up to August 4 (inclusive) were made in the manner requested by Professor Eastman by two similar pointings at α and 1, the prism then being rotated 90° (*i.e.* a visual rotation of the image of 180°) and two further similar pointings made at 7 and δ. From August 5 to September 21 the prism was rotated 90° in the same direction after each pointing, so that the image was presented to the observer under every possible variety of reversion. Corrections for refraction and curvature of the path, as well as those for division-error, screw-error, and runs, have been rigorously applied, but the corrections for parallax of the planet, and for reduction to the mean places of the stars, have been omitted, as they must in any case be recomputed on a rigorous and uniform basis by anyone who undertakes a discussion of the observations.

The zenith distances have been referred to the nadir.

The initials of the observers P. and C. are those of Messrs. R. T. Pett and W. H. Cox.

Royal Observatory, Cape of Good Hope:
1892 *December* 10.

Observations of Mars and Comparison Stars made at the Royal Observatory, Cape of Good Hope, 1892.

Date. 1892.	Obs.	*O. Arg. S.* 20970.	*η Capricorni.*	*27 Capricorni.*	*φ Capricorni.*	*Mars.*	*Lacaille* 8851.	*41 Capricorni.*	*D. M.* −20 6293.	*Lalande* 42700.
		112° 25′	110° 16′	110° 59′	111° 5′		113° 55′	113° 44′	110° 4′	111° 38′
June 28	P	...	48″·98	17″·34	52″·40	110° 21′ 21″·66	56″·44	55″·86	30″·27	51″·97
30	P	...	48″·11	17″·29	52″·28	110° 27′ 20″·59	56″·46	55″·86	29″·88	51″·79
July 1	C	4″·25	49″·21	17″·54	53″·13	110° 30′ 39″·93	56″·65	55″·59	29″·63	51″·75
6	P	3″·29	47″·61	16″·19	50″·99	110° 50′ 28″·00	54″·82	54″·15	28″·04	50″·37
7	C	3″·21	47″·89	16″·38	51″·68	110° 55′ 3″·00	56″·12	55″·24	28″·83	50″·58
8	P	3″·78	48″·30	17″·51	52″·12	110° 59′ 49″·98	56″·15	55″·40	29″·37	51″·21
11	C	5″·30	49″·06	17″·05	52″·80	111° 15′ 14″·54	55″·81	55″·14	29″·19	50″·68
19	C	3″·34	48″·05	16″·85	51″·78	112° 2′ 50″·02	55″·61	54″·74	28″·48	50″·72
20	P	3″·06	47″·22	15″·70	50″·73	112° 9′ 13″·39	54″·79	54″·20	27″·51	50″·04
22	P	2″·98	47″·89	16″·49	51″·94	112° 22′ 11″·12	55″·50	54″·95	28″·47	50″·36
26	P	2″·90	47″·27	15″·69	50″·84	112° 48′ 5″·98	54″·61	53″·82	27″·48	49″·59

Date. 1892.	Obs.	*Lacaille* 8463.	*Lacaille* 8506.	*17 Capricorni.*	*Lacaille* 8612.	*Mars.*	*Lacaille* 8813.	*Lacaille* 8832.	*Lacaille* 8851.	*O. Arg. S.* 21562.
		112° 44′	114° 36′	111° 54′	114° 11′		114° 17′	115° 39′	113° 55′	112° 24′
July 27	C	53″·07	10″·55	...	8″·71	112° 54′ 29″·20	...	...	...	...
28	P	52″·74	11″·55	16″·67	9″·03	113° 0′ 47″·79	4″·62	46″·75	53″·85	57″·36
30	P	52″·80	11″·09	16″·72	9″·42	113° 13′ 6″·69	4″·77	47″·28	55″·23	57″·26
Aug. 1	P	53″·33	11″·50	16″·97	8″·75	113° 24′ 52″·57	4″·41	46″·84	54″·89	56″·81
2	C	52″·77	11″·36	16″·94	9″·21	113° 30′ 31″·52	4″·62	47″·53	55″·35	57″·13
3	P	51″·82	10″·39	16″·58	9″·42	113° 35′ 59″·97	3″·96	46″·72	54″·23	58″·03
4	C	53″·18	12″·00	17″·59	9″·55	113° 41′ 15″·60	4″·99	47″·28	55″·62	57″·29
5	P	52″·48	11″·13	16″·91	9″·01	113° 46′ 18″·79	4″·93	47″·27	55″·07	57″·49
6	C	52″·27	11″·34	16″·39	...	113° 51′ 8″·71	...	...	...	...
10	C	53″·75	13″·31	18″·58	10″·06	114° 8′ 0″·88	5″·48	47″·93	55″·74	57″·59

Date. 1892.	Obs.	*O. Arg. S.* 20429.	*Lacaille* 8463.	*Lacaille* 8506.	17 *Capricorni.*	*Mars.*	*Lacaille* 8734.	*Lalande* 41404.	ζ *Capricorni.*	37 *Capricorni.*
		113° 49′	112° 44′	114° 36′	111° 54′		115° 17′	112° 50′	112° 52′	110° 33′
Aug. 11	P	...	52″·54	11″ 17	16″·59	114° 11′ 32″·51	13″·33	28″·51	35″·29	46″·65
12	C	2″·07	53″·65	11″·69	17″·02	114° 14′ 47″·23	13″·26	28″·49	35″·50	46″·94
16	C	...	53″·11	...	17″·10	114° 24′ 48″·95	13″·05	28″·31	35″·30	45″·66
18	C	1″·95	53″·79	12″·08	17″·08	114° 27′ 57″·72	11″43	...	...	...
19	P	1″·25	52″·38	11″·47	16″·66	114° 29′ 3″·17	13″·92	28″·92	35″·53	47″·20
20	C	1″·97	53″·12	12″·32	17″·84	114° 29′ 51″·35	13″·20	28″·34	33″·93	45″·85
22	C	2″·28	53″·69	12″·39	17″·48	114° 30′ 25″·31	13″·38	...	...	...
24	C	2″·62	54″·25	11″·87	17″·70	114° 29′ 43″·50	13″·69	28″·81	36″·20	46″·83
26	C	...	53″·66	...	17″·87	114° 27′ 44″·93	...	...	34″·91	...
29	P	2″·43	53″·97	12″·56	...	114° 22′ 27″·99	13″·82	29″·27	35″·92	46″·41
30	C	...	53″·38	...	17″·63	114° 20′ 6″·35	14″·00	29″·57	36″·20	47″·23
Sept. 1	C	1″·60	54″·10	12″·22	17″·42	114° 14′ 31″ 42	14″·47	28″·47	35″·35	46″·43
2	P	2″·84	53″·87	12″·72	17″·81	114° 11′ 18″·07	13″·69	28″·77	35″·92	46″·58
3	C	3″·32	54″·47	13″·19	18″·13	114° 7′ 48″·58	14″·62	29″·34	35″·85	47″·05
6	P	3″·16	54″·25	13″·39	17″·94	113° 55′ 45″·26	14″·73	29″·62	36″·73	47″·36
7	C	2″·61	54″·69	12″·99	18″·61	113° 51′ 14″·02	15″·09	30″·13	36″·16	47″·78
8	P	2″ 87	54″·96	13″·49	18″·30	113° 46′ 27″·57	...	...	...	...
12	P	3″·46	54″·72	13″·24	18″·46	113° 25′ 3″·43	15″·00	29″·92	16″·74	47″·76
13	C	3″·43	54″·75	13″·58	18″·76	113° 19′ 8″·98	15″·23	30″·07	36″·66	47″·77
14	P	3″·43	54″·67	13″·04	19″·07	113° 13′ 2″·09	...	...	36″·58	47″·00
15	C	...	54″·65	13″·55	18″·42	113° 6′ 41″·20	14″·74	30″·09	36″·96	47″·59
17	C	3″·82	55″·11	14″·15	18″·72	112° 53′ 24″·13	15″·39	30″·48	36″·73	...
19	C	3″·77	55″·19	13″·72	18″·92	112° 39′ 18″·81	14″·93	30″·90	37″·26	48″·17
20	P	4″·18	54″·99	13″·99	18″·82	112° 31′ 58″·48	15″·30	30″·73	36″·76	48″·15
21	C	4″·16	55″·51	14″·65	19″·27	112° 24′ 26″·85	16″·04	30″·78	37″·40	48″·76

On the Determination of the Equations for the Perturbation of the Inclination and Node of an Orbit by the Method of Variation of Constants. By Robert Bryant, D.Sc., B.A.

The method adopted by Oppolzer and by Watson for determining the differential equations for the change in the position of the plane of the orbit seems to me less simple than the following.

Taking the sun's centre as origin, let three rectangular axes be chosen, whose positions will be more closely specified hereafter.

Let

x, y, z be the coordinates of the disturbed planet,

and

x, y', z' „ „ disturbing „

Then k being the Gaussian constant and p the semi-parameter of the orbit, we have

$$k\sqrt{p(1+m)}\cos i = xv_y - yv_x$$
$$k\sqrt{p(1+m)}\sin \Omega \sin i = yv_z - zv_y$$
$$-k\sqrt{p(1+m)}\cos \Omega \sin i = zv_x - xv_z$$

where v_x, v_y, v_x, are the velocities of the disturbed planet parallel to the coordinate axes.

By the differentiation of these equations and the introduction of suitable modifications we obtain the required results.

Now the quantities on the right-hand sides of the above equations are subject to two distinct kinds of variation: one arising from a change in the time only, such as occurs in the case of undisturbed motion; the other, that arising from the perturbation. Denote the former of these by the symbol $\frac{d_1}{dt}$, and the latter by $\frac{d_2}{dt}$, and let $\frac{d}{dt}$ denote the total variation,so that

$$\frac{d}{dt} = \frac{d_1}{dt} + \frac{d_2}{dt}.$$

Then putting for brevity

$$P = k\sqrt{p(1+m)},$$

we have

$$\frac{dP}{dt}\cos i - P\sin i\frac{di}{dt} = \frac{dx}{dt}v_y + x\frac{dv_y}{dt} - \frac{dy}{dt}v_x - y\frac{dv_x}{dt}.$$

$$\frac{dP}{dt}\sin \Omega \sin i + P\cos \Omega \sin i\frac{d\Omega}{dt} + P\sin \Omega \cos i\frac{di}{dt}$$
$$= \frac{dy}{dt}v_2 + y\frac{dv_2}{dt} - \frac{dz}{dt}v_y - z\frac{dv_y}{dt}.$$

$$\frac{dP}{dt}\cos \Omega \sin i - P\sin \Omega \sin i\frac{d\Omega}{dt} + P\cos \Omega \cos i\frac{di}{dt}$$
$$= \frac{dz}{dt}v_x + z\frac{dv_x}{dt} - \frac{dx}{dt}v_z - x\frac{dv_z}{dt}.$$